

Technical Reports Officer
Grants & Research Contracts
Office of Space Sciences
National Aeronautics and Space Administration
Washington 2, D.C.

Attention: NSG 14-59 Supplement II

Subject: Semi-annual Status Report on Control of
Nuclear Rocket, No. 2, progress report.

Gentlemen:

The following material is submitted for the progress report on the work of Research Grant No. NSG 14-59 Supplement II covering the period 1, July 1965 through 30, December 1965.

(1) By arrangement with the LASL, the undersigned visited the laboratory for two fruitful weeks in late August 1965. Nuclear rocket control problems were discussed with Dr. Joseph Perry and Dr. Ronald Mohler of group N-4. The publications under the present grant for the past two years were reviewed (see attached sheets).

(2) Thanks to the enthusiasm of Dr. J.C. Rowley, several meetings were made possible to discuss various topics to the N-7 group, especially to Mr. R.G. Lantieri. Subjects of common interest such as transient thermal stresses were studied in length during the visit at LASL.

(3) A draft of a proposal entitled "Dynamics and Optimal Control of Nuclear Rocket Heat Exchange with Thermal Stress Limitation" was made and discussed with the N-4 and N-7 groups at LASL, and also later to Mr. J.E. Morrissey of the A.E.C.

(4) A paper is nearly completed on the thermal stress problems of a nuclear reactor due to sudden change of hydrogen flow.

Very truly yours,

C. H. Schmitt
C. H. Schmitt
Professor of Mechanical Engineering

CNSC 10
The Director

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FORM 608

Publication Under the Present Grant

It is the policy of the senior investigator to publish quality papers in established professional journals or present at international conferences from the work of the research grant. The present publications serve the purpose of providing basic knowledge and background for the future study of Optimal Control of Nuclear Rockets. The publications under the grant are:

(A) Three papers during the first academic year (June 1963-June 1964)

- (1) Shen, C.N. & Haag, F.G. (doctoral student under the grant) "Adaptive Control for Nuclear Reactor Start-up and Regulation." Presented at the Ninth Annual Meeting of the American Nuclear Society, June 1963, at Salt Lake City. Transaction of the American Nuclear Society, Vol. 6, No. 1, pp 109-110, June 1963.
- (2) Shen, C.N. & Haag, F.G. "Application of Optimal Control to Nuclear Reactor Start-up," Transactions of Nuclear Science, IEEE, Vol. NS-11, No. 2, April 1964.
- (3) Shen, C.N. & Haag, F.G. "Optimum Control with Desired Input Piece-wise Continuous," Trans. Joint Automatic Control Conference, June 1964, Stanford, California.

(B) Four papers during the second academic year (July 1964-June 1965)

- (4) Shen, C.N. & Haag, F.G. "Optimum Nuclear Rocket Start-up to Develop Full Power at Exact Time with

Consideration of Noise." Presented at the Sixth International Instruments and Measurement Conference, special section on Automatic Control, Stockholm, Sweden, Sept. 1964.

- (5) Shen, C.N. and Haag, F.G. "Optimum Control for Nuclear Rockets" Rensselaer Polytechnic Institute, Mechanical Engineering Dept., Report No. AC2, Nov. 1964.
- (6) Shen, C.N & Liu, T.C. (doctoral student under the grant) "The Control of Absorption Cross-section for a Nuclear Rocket." Presented at the symposium on Neutron Dynamics and Control at the University of Arizona, sponsored by AEC, April 1965, to be published as the proceeding of the AEC Symposium.
- (7) Shen, C.N & Liu, T.C. "Distributed Parameter Type of Control for a Bilinear System." Rensselaer Polytechnic Institute, Mechanical Engineering Department, Report No. AC4, April 1965.
- (C) Beginning of the third Academic year (July 1965-)
- (8) Shen, C.N. & Liu, T.C. "Distributed Parameter Type of Control for a Bilinear System with Reference to Control of a Nuclear Reactor." Paper accepted by the American Automatic Control Council for presentation at the Third Congress of the International Federation of Automatic Control, London, England, June 1966.

Distribution:

NASA (25)

AEC:	Mr. Francis C. Schwenk,	(1)
	Mr. J.E. Morrissey,	(2)
	Dr. J.E. Perry, LASL, N-4	(1)
	Dr. J.C. Powley, LASL, N-7	(1)
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